1.	(a)	$\vec{AE} = \frac{1}{2}\vec{AD}$	*A1*	
		attempt to find $\vec{AD}$ *e.g.* $\vec{AB} + \vec{BD}$, $\boldsymbol{u} + \boldsymbol{v}$	*M1*	
		$\vec{AE} = \frac{1}{2}(\boldsymbol{u} + \boldsymbol{v})$ $\left(= \frac{1}{2}\boldsymbol{u} + \frac{1}{2}\boldsymbol{v}\right)$	*A1*	*N2*
				[3 marks]
	(b)	$\vec{ED} = \vec{AE} = \frac{1}{2}(\boldsymbol{u} + \boldsymbol{v})$	*A1*	
		$\vec{DC} = 3\boldsymbol{v}$	*A1*	
		attempt to find $\vec{EC}$ *e.g.* $\vec{ED} + \vec{DC}$, $\frac{1}{2}(\boldsymbol{u} + \boldsymbol{v}) + 3\boldsymbol{v}$	*M1*	
		$\vec{EC} = \frac{1}{2}\boldsymbol{u} + \frac{7}{2}\boldsymbol{v}$ $\left(= \frac{1}{2}(\boldsymbol{u} + 7\boldsymbol{v})\right)$	*A1*	*N2*
				[4 marks]
				Total [7 marks]
2.	(a)	min value of r is -1, max value of r is 1	*A1A1*	*N2* ***[2 marks]***
	(b)	C	*A1*	*N1* ***[1 mark]***
	(c)	linear, strong negative	*A1A1*	*N2* ***[2 marks]***
				Total [5 marks]

3.	(a)		$4\ (\text{m s}^{-1})$	*A1*	*N1* ***[1 mark]***
	(b)		recognising that acceleration is the gradient *e.g.* $a(1.5) = \frac{4-0}{2-0}$	*M1*	
			$a = 2\ (\text{m s}^{-2})$	*A1*	*N1* ***[2 marks]***
	(c)		recognizing area under curve *e.g.* trapezium, triangles, integration	*M1*	
			correct substitution *e.g.* $\frac{1}{2}(3+6)4$, $\int_0^6 \lvert v(t) \rvert \mathrm{d}t$	*A1*	
			distance $= 18$ (m)	*A1*	*N2* ***[3 marks]***
					Total [6 marks]
4.	(a)	(i)	new mean is $20 + 10 = 30$	*A1*	*N1*
		(ii)	new sd is 6	*A1*	*N1* ***[2 marks]***
	(b)	(i)	new mean is $20 \times 10 = 200$	*A1*	*N1*
		(ii)	**METHOD 1**		
			variance is 36	*A1*	
			new variance is $36 \times 100 = 3600$	*A1*	*N2*
			METHOD 2		
			new sd is 60	*A1*	
			new variance is $60^2 = 3600$	*A1*	*N2* ***[3 marks]***
					Total [5 marks]

5.	(a)	attempt to use substitution or inspection	*M1*	
		e.g. $u = 1 + e^x$ so $\frac{du}{dx} = e^x$		
		correct working	*A1*	
		e.g. $\int \frac{du}{u} = \ln u$		
		$\ln(1 + e^x) + C$	*A1*	*N3*
				[3 marks]
	(b)	**METHOD 1**		
		attempt to use substitution or inspection	*M1*	
		e.g. let $u = \sin 3x$		
		$\frac{du}{dx} = 3\cos 3x$	*A1*	
		$\frac{1}{3}\int u\,du = \frac{1}{3} \times \frac{u^2}{2} + C$	*A1*	
		$\int \sin 3x \cos 3x dx = \frac{\sin^2 3x}{6} + C$	*A1*	*N2*
				[4 marks]
		METHOD 2		
		attempt to use substitution or inspection	*M1*	
		e.g. let $u = \cos 3x$		
		$\frac{du}{dx} = -3\sin 3x$	*A1*	
		$-\frac{1}{3}\int u\,du = -\frac{1}{3} \times \frac{u^2}{2} + C$	*A1*	
		$\int \sin 3x \cos 3x dx = \frac{\cos^2 3x}{6} + C$	*A1*	*N2*
				[4 marks]

METHOD 3		
recognizing double angle	*M1*	
correct working	*A1*	
e.g. $\frac{1}{2}\sin 6x$		
$\int \sin 6x dx = \frac{-\cos 6x}{6} + C$	*A1*	
$\int \frac{1}{2}\sin 6x dx = -\frac{\cos 6x}{12} + C$	*A1*	*N2*
		[4 marks]
	Total [7 marks]	

6.	(a)	recognizing double angle *e.g.* $3\times 2\sin x\cos x$, $3\sin 2x$	*M1*	
		$a=3$, $b=2$	*A1A1*	*N3*
				[3 marks]
	(b)	substitution $3\sin 2x=\frac{3}{2}$	*M1*	
		$\sin 2x=\frac{1}{2}$	*A1*	
		finding the angle *e.g.* $\frac{\pi}{6}$, $2x=\frac{5\pi}{6}$	*A1*	
		$x=\frac{5\pi}{12}$	*A1*	*N2*

Note: Award ***A0*** if other values are included.

[4 marks]

Total [7 marks]

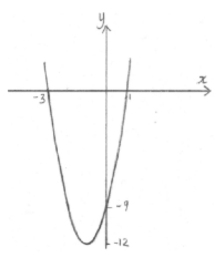
7.	(a)	$f'(x)=-x^{-2}$ $\left(\text{or } -\frac{1}{x^2}\right)$	*A1*	*N1*
		$f''(x)=2x^{-3}$ $\left(\text{or } \frac{2}{x^3}\right)$	*A1*	*N1*
		$f'''(x)=-6x^{-4}$ $\left(\text{or } -\frac{6}{x^4}\right)$	*A1*	*N1*
		$f^{(4)}(x)=24x^{-5}$ $\left(\text{or } \frac{24}{x^5}\right)$	*A1*	*N1*
				[4 marks]
	(b)	$f^{(n)}(x)=\frac{(-1)^n n!}{x^{n+1}}$ or $(-1)^n n!\left(x^{-(n+1)}\right)$	*A1A1A1*	*N3*
				[3 marks]

Total [7 marks]

SECTION B

8.	(a)		$f(x)=3(x^2+2x+1)-12$	*A1*	
			$=3x^2+6x+3-12$	*A1*	
			$=3x^2+6x-9$	*AG*	*N0*
					[2 marks]
	(b)	(i)	vertex is $(-1,-12)$	*A1A1*	*N2*
		(ii)	$y=-9$, or $(0,-9)$	*A1*	*N1*
		(iii)	evidence of solving $f(x)=0$ *e.g.* factorizing, formula	*M1*	
			correct working *e.g.* $3(x+3)(x-1)=0$, $x=\frac{-6\pm\sqrt{36+108}}{6}$	*A1*	
			$x=-3$, $x=1$, or $(-3, 0)$, $(1, 0)$	*A1A1*	*N2*
					[7 marks]

(c)



A1A1A1 *N3*

Note: Award ***A1*** for a parabola opening upward,
A1 for vertex in approximately correct position,
A1 for intercepts in approximately correct positions.
Scale and labelling not required.

[3 marks]

[3 marks]

(d) $\begin{pmatrix} p \\ q \end{pmatrix} = \begin{pmatrix} -1 \\ -12 \end{pmatrix}, t = 3$ *A1A1A1* *N3*

[3 marks]

Total [15 marks]

9. (a) (i) number of ways of getting $X = 6$ is 5 *A1*

$\mathrm{P}(X = 6) = \frac{5}{36}$ *A1* *N2*

(ii) number of ways of getting $X > 6$ is 21 *A1*

$\mathrm{P}(X > 6) = \frac{21}{36} \; \left(= \frac{7}{12}\right)$ *A1* *N2*

(iii) $\mathrm{P}(X = 7 \mid X > 6) = \frac{6}{21} \; \left(= \frac{2}{7}\right)$ *A2* *N2*

[6 marks]

(b) attempt to find $\mathrm{P}(X < 6)$ *M1*

e.g. $1 - \frac{5}{36} - \frac{21}{36}$

$\mathrm{P}(X < 6) = \frac{10}{36}$ *A1*

fair game if $\mathrm{E}(W) = 0$ (may be seen anywhere) *R1*

attempt to substitute into $\mathrm{E}(X)$ formula *M1*

e.g. $3\left(\frac{5}{36}\right) + 1\left(\frac{21}{36}\right) - k\left(\frac{10}{36}\right)$

correct substitution into $\mathrm{E}(W) = 0$ *A1*

e.g. $3\left(\frac{5}{36}\right) + 1\left(\frac{21}{36}\right) - k\left(\frac{10}{36}\right) = 0$

work towards solving *M1*

e.g. $15 + 21 - 10k = 0$

$36 = 10k$ *A1*

$k = \frac{36}{10} \; (= 3.6)$ *A1* *N4*

[8 marks]

Total [14 marks]

10. (a)	$f'(x) = -\sin x + \sqrt{3}\cos x$	*A1A1*	*N2*
			[2 marks]
(b) (i)	at A, $f'(x) = 0$	*R1*	
	correct working *e.g.* $\sin x = \sqrt{3}\cos x$	*A1*	
	$\tan x = \sqrt{3}$	*A1*	
	$x = \frac{\pi}{3}, \frac{4\pi}{3}$	*A1*	
	attempt to substitute **their** x into $f(x)$ *e.g.* $\cos\left(\frac{4\pi}{3}\right) + \sqrt{3}\sin\left(\frac{4\pi}{3}\right)$	*M1*	
	correct substitution *e.g.* $-\frac{1}{2} + \sqrt{3}\left(-\frac{\sqrt{3}}{2}\right)$	*A1*	
	correct working that clearly leads to -2 *e.g.* $-\frac{1}{2} - \frac{3}{2}$	*A1*	
	$q = -2$	*AG*	*N0*
(ii)	correct calculations to find $f'(x)$ either side of $x = \frac{4\pi}{3}$ *e.g.* $f'(\pi) = 0 - \sqrt{3}$, $f'(2\pi) = 0 + \sqrt{3}$	*A1A1*	
	$f'(x)$ changes sign from negative to positive	*R1*	
	so A is a minimum	*AG*	*N0*
			[10 marks]

(c)	max when $x = \frac{\pi}{3}$	*R1*	
	correctly substituting $x = \frac{\pi}{3}$ into $f(x)$ *e.g.* $\frac{1}{2} + \sqrt{3}\left(\frac{\sqrt{3}}{2}\right)$	*A1*	
	max value is 2	*A1*	*N1*
			[3 marks]
(d)	$r = 2$, $a = \frac{\pi}{3}$	*A1A1*	*N2*
			[2 marks]
			Total [17 marks]